FPU2025 -High entropy alloy nanoparticles for catalysis applications

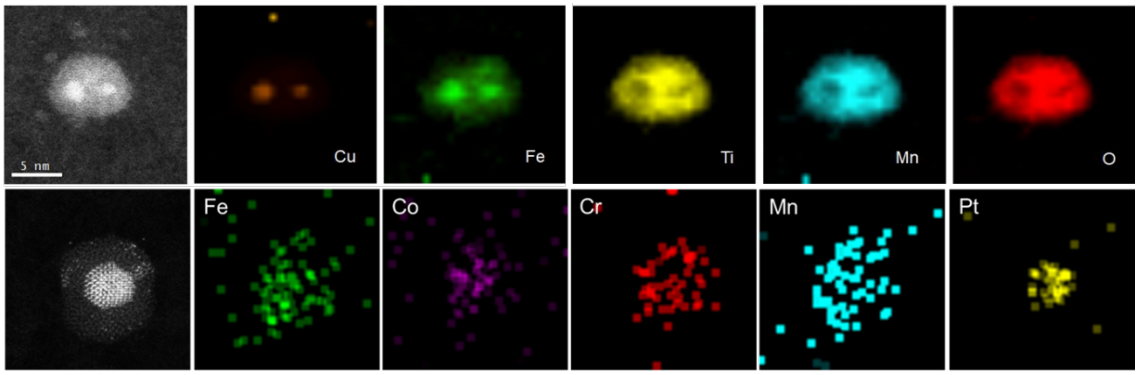
The main goal of this thesis will the validation of precious metal-free High Entropy Alloy (HEA) nanoparticles (NPs) fabricated by physical methods as catalyst for electro and photocatalysis. HEA NPs are equiatomic systems of five or more elements that can crystallize as a single phase, despite containing multiple elements with different crystal structures.

To date, HEAs have been studied primarily as bulk materials or thin films, and the few existing studies on NPs have been synthesized by chemical methods. In this context, gas-phase synthesis of HEA NPs appears as a very promising alternative, since this method allows fabrication outside of thermodynamic equilibrium without the restriction of redox potentials.

The work purposed here proposes the fabrication of HEA NPs under ultra-high vacuum conditions, using a nanoparticle source (physical method). These NPs are good candidates to replace expensive or critical raw materials used as catalysts. The candidate will be trained in fabrication techniques and characterization of their atomic (TEM), morphological (AFM) and chemical (XPS) structures as well as magnetic properties (SQUID). Through collaborations with expert groups, the catalytic properties of these nanoparticles (NPs) and their viability for catalytic applications will be evaluated.

The host group at the ICMM will be LAM (Low Dimensional Advanced Materials), which specializes in nanoparticle source fabrication. The group has access to three aggregate sources with which the HEA NPs will be fabricated. We started this new research line of multielement NPs two years ago and, given the good results obtained, we have written different proposals for national and international project funding.

The image shows an example of the first nanoparticles fabricated from four elements (top) as a preliminary step to the five (bottom) elements that will be explored in this doctoral thesis proposal.



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GRUP: Low dimensional Advanced Materials (LAM), https://wp.icmm.csic.es/lam/